A) General Information

Acronym: DEIAgrid
Title of the User-Project: Distributed Energies Integration in an Autonomous Grid
TA Call: 30th June 2012
Host Research Infrastructure: Institute of Communication and Computer Systems- National Technical University of Athens (ICCS-NTUA)
Starting Date: 4/02/2013
End Date: 8/03/2013

Lead User (Name-Institution-Country): Konstantina Mentesidi, National Renewable Energies Centre of Spain (CENER)
Additional Users (Name-Institution-Country): --

B) Summary of the User-Project

The purpose of DEIAgrid project was to investigate the effects of the Static Synchronous compensator (STATCOM) on voltage stability of a low voltage (LV) distribution system. Generally, the STATCOM is a shunt device that regulates the system voltage and mitigates voltage sags by absorbing or generating reactive power. Subjects like voltage stability of the network nodes were analyzed. Within the current project an Average Model of STATCOM was utilised where the IGBT Voltage-Source Converter was represented by equivalent controlled voltage sources generating the AC voltage into the network whereas PWM switching frequencies were neglected. Moreover, the integration and control of an energy storage system (ESS) such as a Supercapacitor was investigated throughout this work. In more details, a Supercapacitor of 400 V was also simulated to match the DC voltage requirement to aid to enhance the distribution system reliability by maintaining the STATCOM DC voltage constant under different load demand profiles. In continuation, power hardware-in-the-loop experiments (PHIL) there were executed by utilizing an impedance of resistive and reactive load of 78 and 32.36 Ohms respectively as hardware under test (HuT).

Additionally, the DEIAgrid project aimed at modelling the Bootstcap Maxwell Supercapacitor that the ICCS-NTUA laboratory owns by taking into consideration the conducted experimental measurements. Its maximum stored energy was at 6.5 kJ with nominal capacitance of 58 F and nominal voltage of 15 V. The experiment consisted of charging the Supercapacitor at a current of 3 A, until the voltage reached the value of 30 V (two Supercapacitors connected in series), then the current was cut off for about 10 minutes. Subsequently, with the assistance of a rheostat, a resistance of 10 Ohms was applied to the circuit to discharge the Supercapacitor. In that way, an experimental complete cycle of charging and discharging on a real energy storage device was executed in the Lab environment.

C) Main Achievements

In overall, familiarity with the RTDS system was achieved. The stability of the power-hardware-in-the-loop experiment was evaluated and achieved. Throughout the PHIL experiments, it was proven that the STATCOM improves the voltage stability at the connection point and the Supercapacitor aids to keep the DC link voltage constant to its nominal value with a PI controller maintaining the primary voltage equal to the reference value defined in the control system dialog box.

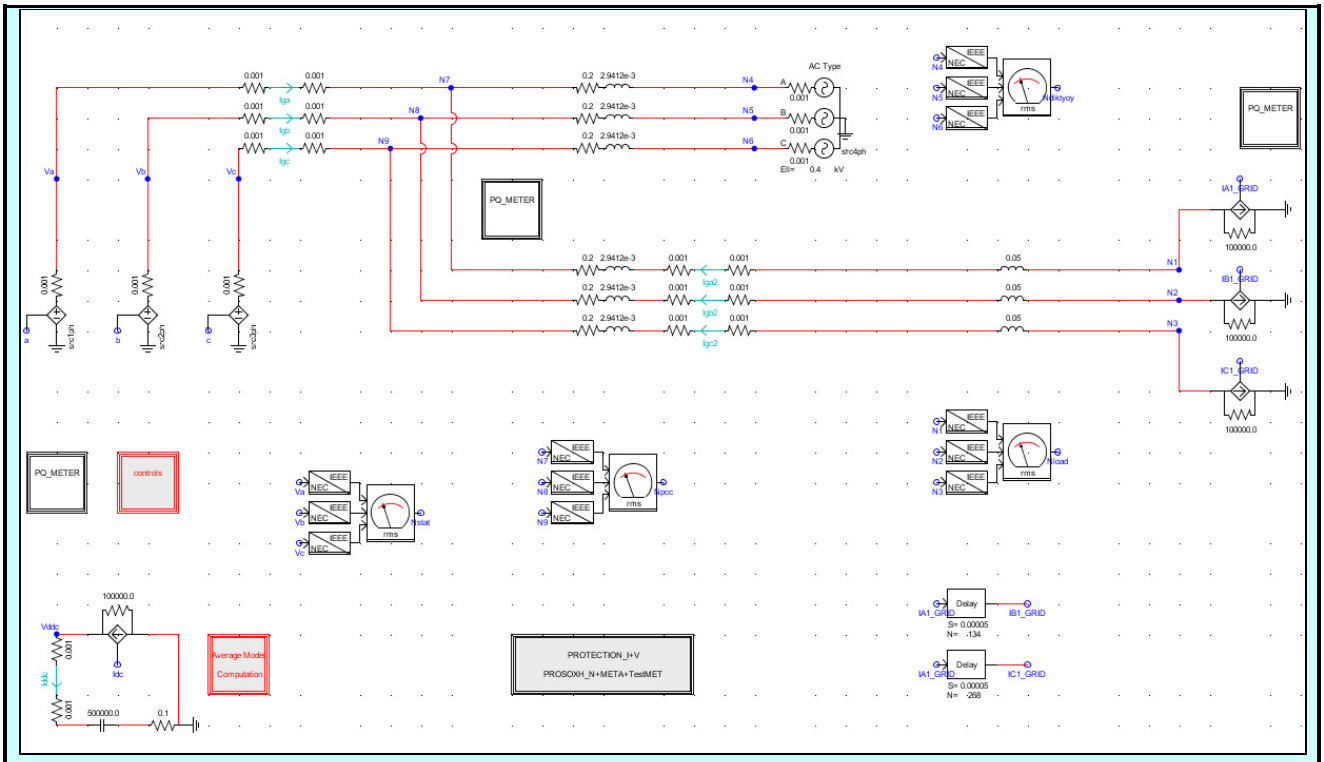

Figure 1: RSCAD/RTDS model with STATCOM during the PHIL test

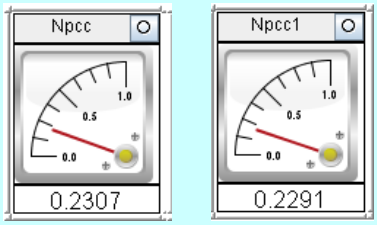

Figure 2: Voltage profile at the load connection point with and without STATCOM during the PHIL test

D) Dissemination of the Results

An IEEE Transactions paper is planned, which will describe the experimental procedure that was followed in ICCS-NTUA lab and the extended work developed in CENER. The results will be presented as well as conclusions. Moreover, participation in a technical conference will be scheduled.

E) Use of the Resources

Access Days/Units (ICCS-NTUA): 25
Stay Days (ICCS-NTUA): 36